

Application No.: 10/055,157

Docket No.: JCLA4827-CIP

AMENDMENTFor the Specification:

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The formation method of the insulating layer mentioned above is, for example, high density plasma chemical vapor deposition (HDPCVD). The high density plasma of HDPCVD has a bombarding effect; therefore the insulating layer has substantially-vertical sidewalls above the edge of the active areas. The screen layer is formed by, for example, floatable precursors. The floatable precursor fills up the low-lying place, i.e., above the trenches, to protect the thin layer above trenches. Hence, when the thin layer and the insulating layer above the active areas are removed, the insulating layer above the trenches is not hurt.

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The material of the insulating layer 140 includes, for example, silicon oxide, and the formation method of the insulating layer 140 includes, for example, HDPCVD. Since the high density plasma of HDPCVD has an etching effect simultaneously during deposition, the deposition rate to the etching rate ratio can thus be controlled to result in obtaining substantially vertical sidewalls 145 of the insulating layer 140 over the active regions 105 above the substrate 100. For example, by tuning process conditions, including D/S ratio about 4.0, bias (RF power) about 3000kW, temperature about 300-380°C and pressure about 5 mT, a substantially-vertical sidewall can be formed. Preferably, the process parameters can be further fine-tuned to obtain substantially-vertical sidewalls, as the following exemplary conditions: RF power (top): 1200-1450W; RF power (side): 2900-3380W; RF bias power match box (off); Ar gas flow rate: 80-135 sccm; Ar gas (top) flow rate: 10-20 sccm; O₂ gas flow rate: 188-245 sccm; O₂ gas (top) flow rate: 22-40 sccm; SiH₄ gas flow rate: 100-128 sccm; SiH₄ gas (top) flow rate: 12-22 sccm; and pressure control: T.V. setting 700-880 steps. However, the present invention is not limited by the aforementioned parameters, since these parameters are only exemplary.

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A thin film 150 is formed on the insulating layer 140. The material of the thin film 150 is preferably selected from a material with good removal selectivity over the insulating layer 140. For example, when the insulating layer 140 is made of silicon oxide, the thin film 150 material can be made of silicon nitride or polysilicon. The thickness of the thin film 150 is preferably about 100 to about 500 Å, for example, about 200Å, which is about the thickness of the pad oxide 110. The formation method of the thin film 150 is, for example, chemical vapor deposition. Due to the substantially-vertical geometry of the sidewalls 145, the thin film 150 deposited on the sidewalls 145 is thinner than that on other positions. As shown in Fig. 1B, while a sputtering step is applied instead of chemical vapor deposition, almost no thin film 150 can be formed on the sidewalls 145.